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DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
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METHODS AND COSTS OF DEVELOPING AND EQUIPPING THE ASHLEY GOLD MINE, MATACHEWAN GOLD DISTRICT, ONTARIO

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W. H. EMENS AND CHAS. F. JACKSON

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METHODS AND COSTS OF DEVELOPING AND EQUIPPING THE ASHLEY GOLD MINE, MATACHEWAN GOLD DISTRICT, ONTARIO[1]

By W. E. Emens[2] and Chas. F. Jackson[3]

INTRODUCTION

This circular is one of a series dealing with the development and equipment of small and medium size mines, and with the costs of such work prior to productive operation. The preparation and publication of these papers by the Bureau of Mines has been made possible through the cooperation of various mining and development companies.

The Bureau of Mines has published a series of circulars dealing with mining methods and costs at a large number of producing mines in the United States, Canada, Mexico, and other countries. Unit costs of development work, shaft sinking, drifting, crosscutting, tunneling, and raising are usually much higher in the preliminary development of a property than during its productive life.

During the development period of a mine, not only are direct labor and supply costs chargeable to the underground work, but also all indirect costs, such as hoisting, pumping, power, office, and surface labor, which at a producting property are prorated between development and ore production.

Frequently the development must bear the costs of road or tramway construction, and in remote districts not yet provided with organized transport facilities, costs for freighting and hauling equipment and supplies are excessive during the development period. During development it is often necessary to sacrifice economy to obtain speed, and also as the habits of the orebodies, nature of the ground, etc., have not yet been fully determined, advantage can not as a rule be taken of the economies incident to a well-organized routine of operations which are obtainable in most producing mines. Further, in development work, and particularly in its early stages, crews must be organized and frequent changes in their personnel are often necessary.

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All these factors serve to make costs higher during the early stages of mine development than the costs of similar work at an old producing property. A series of circulars describing methods and costs of mine development and equipment during the period prior to the beginning of productive operations should be of value, and by comparison with the earlier series on mining methods and costs, will serve to emphasize the contrast between development and productive operations.

This paper describes and discusses the exploration, development, and equipment of the Ashley mine, beginning with the original discovery by Bert Ashley in October, 1930, continuing with the exploration by trenching and diamond drilling, the shaft sinking and lateral development, and concluding with the construction of a milling plant which went into operation at the end of August, 1932.

ACKNOWLEDGMENTS

The authors are indebted to M. F. Fairlie, managing engineer of the Mining Corporation of Canada (Ltd.), and to other officials of the corporation for the data contained in this article and for permission to publish them in their present form. Acknowledgment is made of the assistance of C. F. Cockshutt and Louis Becigneul, respectively mine superintendent and chief accountant, in the compilation of cost and other data presented in this report.

LOCATION AND GENERAL FEATURES OF PROPERTY

The Ashley mine is in the northwest corner of Bannockburn Township, Matachewan gold district, about 32 miles in a straight line from railhead at Elk Lake, or 42 miles by winter road.

In the vicinity of the property, the surface is gently rolling and is marked by low ridges with intervening swampy lowlands. It is covered by a heavy growth of birch, jack pine, spruce, and occasional white pine. Although timber and cordwood are thus plentiful, they are expensive because of being within the Booth timber limit and in the Temagami Forest reserve, which entails the payment to the timber company and the Province of Ontario of combined fees of $2.40 per cord for all cordwood cut and $14.50 per thousand for jack-pine saw timber on the stump. After adding the cost of cutting, teaming, and wastage, the cost per thousand for rough sawed lumber is about $38 and the cordwood cost is about $5.65 per cord.

The Matachewan gold area straddles the height of land and drainage is partly to the north into Nighthawk Lake and partly to the east into the west branch of the Montreal River. There are numerous lakes and small meandering streams. One of these small streams or creeks flows within half a mile of the Ashley property and furnishes a plentiful supply of water for the mine.

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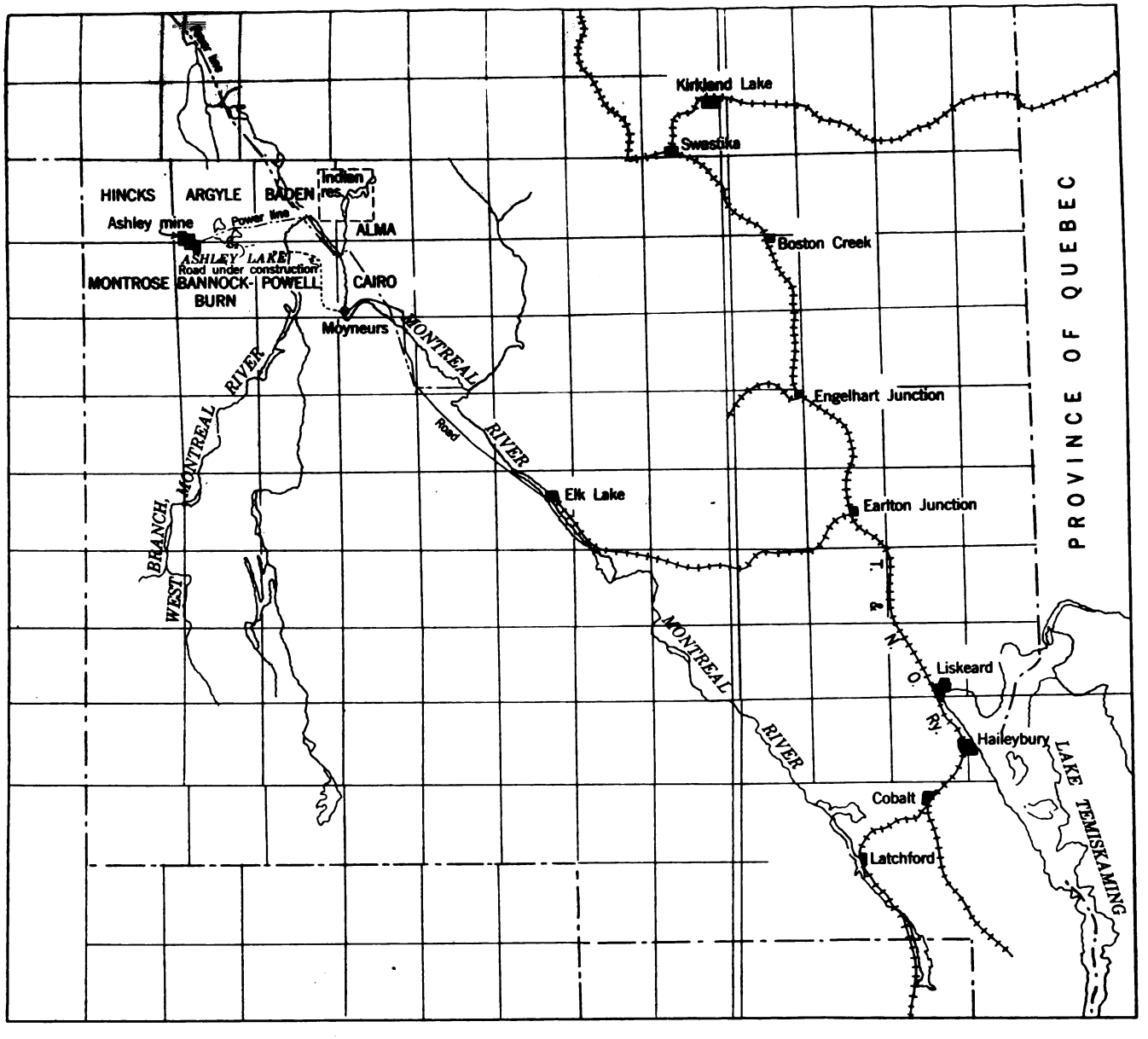

Figure 1.—Key map showing location of Ashley mine

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Climatic Conditions.- The district is at 48° north latitude and the winters are long and severe, short periods of 50° to 40° below zero weather being common. Some years the snowfall is very heavy, and snowfall in May and again late in September is not uncommon. Freeze-up may occur any time from late October to late November and the winter roads generally break up some time in April. The summers are generally quite cool, but occasional very hot spells may occur during late June, July, or early in August. There is apt to be a dry spell following the disappearance of the snow in the spring and before fresh green vegetation appears when bush fires are often prevalent and must be carefully guarded against.

Black flies and mosquitos are annoying during the summer and camps must be screened. Obviously, in the winter the camps must be well heated.

TRANSPORTATION AND COMMUNICATION

Most of the heavy supplies and equipment were hauled in during the winter from Elk Lake to Moyneurs, a distance of 25 miles, and from Moyneurs to the Ashley property, an additional 17 miles, over a rough winter road, or a total haul of 42 miles from railhead at Elk Lake (fig. 1). An automobile road was open from Elk Lake to Moyneurs in 1931 but was not used for summer transportation of supplies. There is a combination truck and water route from Elk Lake to Whitefish Lake (renamed Ashley Lake on the latest maps, since there is another Whitefish Lake farther north) which could have been employed during the summer months. The use of this route would have entailed repeated unloading and loading and carrying over the portages, and transportation by this route would thus have been so slow and expensive that it was not employed. Perishable foodstuffs and such other supplies as it was necessary to bring in during the summer were carried by plane from Elk Lake to Ashley Lake, a flying distance of 30 miles, and were then teamed 3 miles to the property. Visiting officials usually traveled by airplane, though the water route was occasionally employed when flying conditions were unfavorable. Workmen coming in ordinarily traveled to Moyneurs by automobile and from there to Ashley Lake by canoe, making two portages of about a half mile each. On September 1, 1932, a road from Moyneurs to the mine was nearing completion so that the property would soon be accessible by automobile and truck all the way from Elk Lake. The total length of this new road is approximately 17 miles (fig. 1), about 4 miles of which are under construction by the company and the balance by the Province of Ontario.

Supply houses and shops at Cobalt, Haileybury, and New Liskeard could be reached by phone for the quick ordering of supplies early in 1931. A company line at that time connected the mine with the Forestry Service station at Moyneurs, whence messages were relayed to Elk Lake, New Liskeard, or Cobalt. Early in 1932 a regular telephone service was put through to the telephone company's exchange at Elk Lake.

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Winter Hauling.- Winter hauling from Elk Lake was accomplished by means of horse-drawn sleds carrying an average load of 5,500 pounds during the first winter (1930-1931). In addition to the teams, one tractor was in service between Elk Lake and Moyneurs. This tractor pulled two or three sleds with an average load of about 10 tons, although considerably more was taken on some trips. During the second winter five tractors were used between Elk Lake and Moyneurs, while teams were used between Moyneurs and the property. Up to 30 teams were employed during this season on this part of the route, and in addition some hauling was done by team between Elk Lake and Moyneurs. Teams had to be doubled in some instances for hauling the heaviest pieces of freight. When hauling all the way from Elk Lake to the mine by team, five days were required for the round trip -- one and a half days from Elk Lake to Moyneurs and one day from Moyneurs to the mine. Stable capacity for 12 teams was provided at the mine during the second season. The tractors worked continuously, making 4 miles per hour when the road was in good condition.

During the first season about 700 tons of freight were taken in and during the second season 1,457 tons.

All hauling was done either on a cost-plus or on a contract basis. The contract price was $45 per ton during the first winter and $27 per ton during the second winter. The first winter hauling did not start until February and, as the remaining season was short, speed rather than price was the first consideration. Railway freight during the second season amounted to $9,109 or $6.25 per ton, and the hauling cost amounted to $38,299. Of the 1,457 tons handled in 1931, about 45 tons were taken in by plane, leaving a balance of 1,412 tons hauled. Thus the cost of hauling was $27.12 per ton, equivalent to $0.645 per ton-mile.

Airplane Transport.- Airplane service from Elk Lake started immediately after the discovery in October, 1930, and has continued ever since except for about a month during the autumn freeze-up and a month during the break-up in the spring when service is interrupted. In the summer the plane is equipped with pontoons for water landing and in the winter with skis for landing on the ice. Obviously during the early freeze-up and the spring break-up, neither of these methods of landing is applicable. During these two periods dog teams were used to a limited extent for handling mail and such emergency supplies as it was absolutely necessary to bring in between flying seasons.

At Elk Lake the landing is on a lake of that name which is a widening of the Montreal River. At the other end the landing is on Ashley Lake (formerly called Whitefish Lake), 3 miles from the mine.

The plane is a 320-hp., single-motor, 4-seated Bellanca monoplane capable of carrying a maximum pay load of about 1,150 pounds. With the rear seats removed about 130 cubic feet of cargo space are available; the shape and size of individual pieces, however, determine the bulk of the material which can be carried. Thus when standard drums of fuel oil and gasoline would not go through the door, special smaller containers had to be used.

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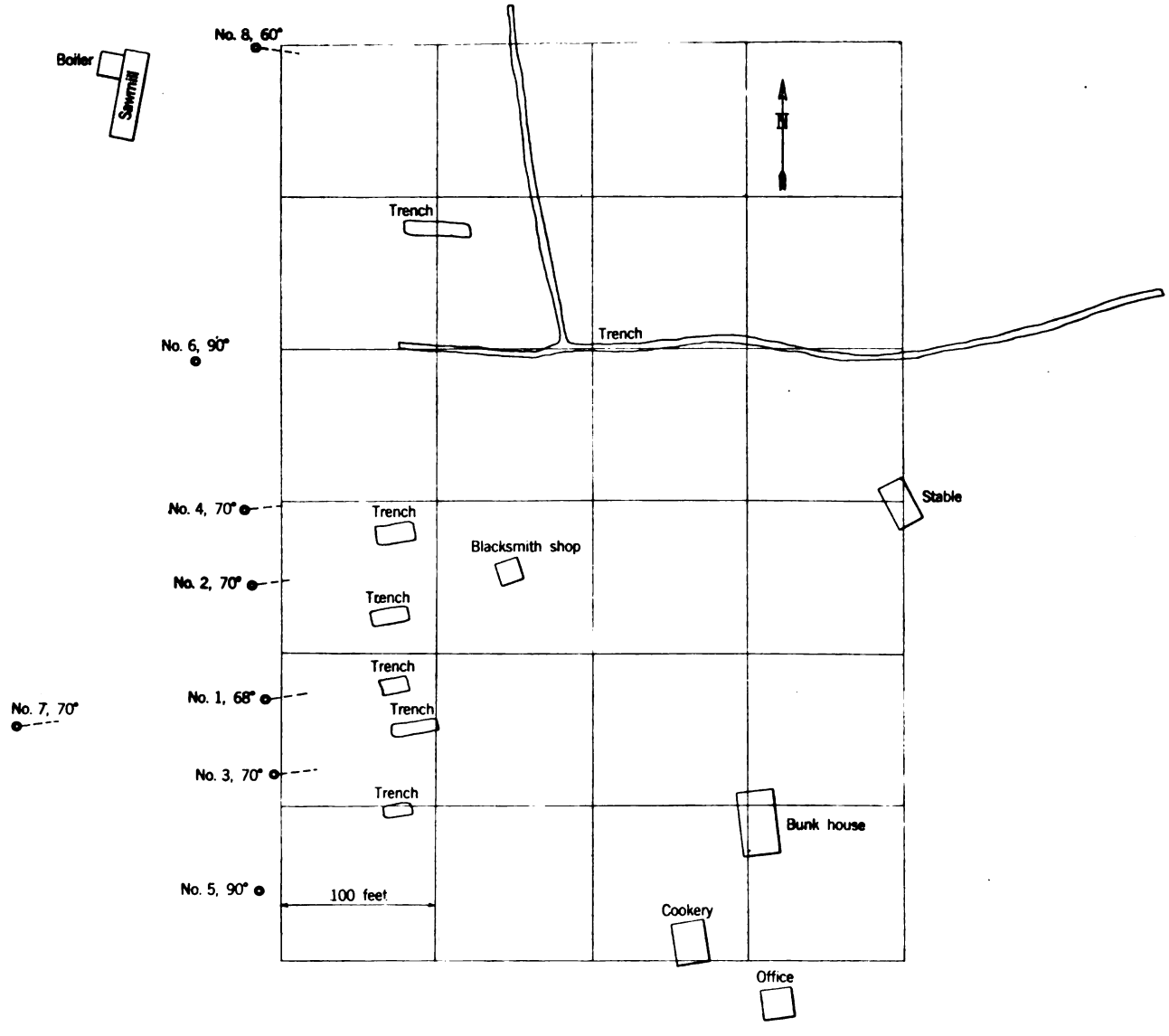

Figure 2.—Plan showing early trenching, first buildings and first diamond-drill holes

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Ordinary cruising speed is 100 miles per hour, though a somewhat higher speed is obtainable. The trip from Elk Lake to the Ashley Lake landing requires 20 to 25 minutes. The plane is operated by General Airways (Ltd.). During 1931 there were a considerable number of prospectors in the district, men were traveling in and out all the time, and the plane made regular daily trips. The fare was then $10 per passenger one way with no minimum charge for the trip. In 1932 the daily trips were discontinued, and the plane was available on call, provided it was not out on trips to other points. During this season there was a minimum rate of $25 per trip for passengers, one way, or $10 per passenger if there were three or more. Freight and baggage were taken at 6 cents per pound, equivalent to $120 per ton or $5.75 per ton-flying-mile. During 1931 about 45 tons of freight were taken in by plane and $2,829 was spent by the company for carrying passengers.

DISCOVERY AND GENERAL GEOLOGICAL FEATURES OF THE DEPOSIT

The Ashley property now embraces 23 mining claims covering 951.7 acres, on one of which the original discovery was made by Bert Ashley in October, 1930. This occurred at a point where a white quartz vein was exposed on the west flank of a north and south ridge and about 15 feet above the level of a muskeg swamp. The quartz was about 2 feet wide and showed pyritic mineralization, free gold, and some telluride (probably lead telluride). The walls are basalt, and the vein strikes a little west of north.

About 100 feet north of the discovery the vein disappears below the swamp and 25 feet to the south the outcrop again goes off the side of the ridge. Four trenches, cut across the vein and spread over a distance of 150 feet along the strike, disclosed the vein, whereas one farther south and another farther north failed to uncover it (fig. 2).

The vein dips toward the west under the swamp at an angle of about 50° so that the hanging wall could not be prospected by trenching.

Samples of the exposed sections of the vein returned good assays, some streaks being of very high grade. In some places the pyrite mineralization is quite coarse and in others it is fine-grained. The gold seems to favor the coarser pyrite. High assays have been obtained from quartz showing but little pyrite, however.

Figure 2 shows the trenching done during the initial stages of prospecting, together with a long east-west trench further north which was dug somewhat later. The latter, beginning near the line of strike of the vein and going east, revealed 200 feet of basalt, 100 feet of diorite, and 200 feet more of basalt. A red granite porphyry intrusion about 100 feet wide cuts across the strike of the vein about 200 feet to the north of the discovery. This may be a dike or the narrow top of a larger granitic mass. The fracture in which the vein occurs continues through and beyond this dike; in the underground workings the vein is not ore-bearing in this formation, though low assays are obtainable.

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As the result of the early exploration, subsequent diamond drilling and underground exploration, a narrow but high-grade quartz vein has been developed which dips at 50° to 55° to the west near the discovery, steepens at depth going north, and flattens to about 30° on the bottom level (500 feet) going south. The vein thus occupies a warped fracture plane. The gold occurs in quartz which fills a fracture or series of closely spaced fractures in altered basaltic lava flows with small, irregular seams or stringers making off into the footwall for short distances at numerous points. These are generally quartz stringers which may or may not carry appreciable value in gold. On the hanging-wall side of the vein there are stringers of white calcite and quartz which are usually barren. Occasional bands of lime-iron carbonate occur in or along the gold-bearing quartz vein.

A "mud seam" comes in at a flat angle (in plan) from the hanging-wall side of the vein near the shaft crosscuts, follows the vein a short distance, and then branches off into the hanging wall again. This seam probably represents a reopened fracture along which there has been some movement which has formed a reverse fault of small displacement.

PRELIMINARY EXPLORATION

The disclosures made in the first trenches warranted further trenching and exploration by diamond drilling. It was soon found impracticable to explore the hanging-wall side of the vein under the muskeg by trenching, and it was therefore decided to bring in two diamond-drill outfits to test the vein below the outcrop and under the swamp as quickly as possible.

Meanwhile surface trenching was continued until some 875 linear feet of trench were dug, including the original trenching. In the following year considerable more trenching was done.

Construction of First Camps.- A crew was sent in ahead of the drillers, and a small temporary camp was hurriedly constructed. About 3 acres of ground were cleared, and the following log-wall buildings were erected:

Building	Size, feet	Cost
Office	20 by 30	$ 344
Blacksmith shop	14 by 16	200
Combined cookery and bunkhouse for 8 men	20 by 30	390
Stable for 3 teams	20 by 40	200
Total	--	1,134

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On October 21, 1930, the first load of supplies was trucked into Elk Lake and consisted of small prospecting tools, blacksmith forge and coal, office stationery, snowshoes, an eiderdown, etc. This was for the most part second-hand material and was valued at $86. On November 18, an additional consignment of used material consisting of tools and cookery equipment for six men from other properties of the company. This consignment was valued at $42. The next consignment, valued at $249, was shipped on December 9 and consisted of camp equipment such as beds and bedding, cooking utensils and tableware, and an anvil and a grindstone.

The original bunk house and cookery were used by the crew engaged in trenching and general surface work. A second bunk house was started December 10 and was ready for occupancy December 19. This was 24 by 42 feet in plan with log walls and a peak roof 21 feet high, and cost $1,294 to build. During December about 5 miles of winter road were cut also. On the 20th of that month the drilling crews arrived, and on the 24th the first diamond-drill hole was started.

The expenditure up to December 31, 1930, stood approximately as follows:

	Cost
First 4 buildings	$ 1,134
Second bunk house	1,294
First three consignments of freight	377
Cookery stores, freight and teaming, miscellaneous pay roll, cookery supplies, travel expenses, etc.	9,195
Total	12,000

Diamond-Drill Exploration.- Diamond drilling was started on December 24, 1930, and by January 7, 1931, four shallow holes had been completed, located as shown in Figure 2 (holes 1, 2, 3, and 4). These holes were 88 to 109 feet deep and totaled 395 feet of drilling. Much difficulty was experienced in these and later holes in getting down to bedrock. Further difficulty was encountered in drilling the rock, which was seamed and fractured; carbon loss was exceptionally high, some of the holes had to be cemented, and core recovery was poor. It was therefore decided about this time to sink a small prospect shaft and have a look at the vein in place at depth. Drilling was continued however, and holes 5 to 10, inclusive, were put down. These holes were completed by February 27, 1931 and comprised a total of 1,314 feet of drilling. Individual holes ranged from 139 to 291 feet in depth. Drilling was then temporarily suspended on the Ashley claims; and the drills were moved to the adjoining Garvey claims, also part of the company's property. Four holes totaling 474 feet in length were drilled on these claims, the drills were then moved back to the Ashley, and holes 15 and 16 were drilled.

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This drilling was all done on a cost-plus basis, and was very expensive because of the difficulties encountered and the high carbon loss. The total footage drilled in holes 1 to 16, inclusive, was 2,743 feet. Later on three more holes were drilled from surface to test the vein and determine its dip, to cut the vein respectively at what would later be the 500, 625, and 750 foot levels of the mine. These three holes comprised a combined footage of 2,044 feet, the deepest being 750 feet deep; they were sunk at a contract price of $4.15 per foot for drilling, with extra charges for cementing, etc., and cost $4.56 per foot on the average.

The company furnished fuel for the drills, which were steam driven.

Following is a summary of the cost of the drilling:

Hole numbers	Feet drilled	Total cost	Cost per foot
1 to 16	2,743	$20,047.92	$7.31
17, 18, 19	2,044	9,320.64	4.56
Total	4,787	29,368.56	6.14

Details of diamond-drilling costs, holes 1 to 16, inclusive

(Feet drilled, 2,743)

	Total cost	Cost per foot
Labor	$ 7,150.52	$2.61
Carbon	8,784.45	3.20
Fuel	380.24	.14
Cement	32.25	.01
Oil, grease, and miscellaneous supplies	149.81	.05
Travel and office expense	896.65	.33
Freight and haulage	104.20	.04
Rental of equipment	2,350.00	.93
Total	20,047.92	7.31

Rental was $15 per drill per day.

UNDERGROUND EXPLORATION AND DEVELOPMENT

As previously indicated, the results of trenching and diamond drilling were not altogether satisfactory, although they were indicative of a narrow vein carrying good values over a considerable length. It was therefore early decided to continue the exploration by underground methods. At first the intention was to sink a small prospect shaft, but before work started the plan was changed to provide a 3-compartment working shaft with levels at 125-foot intervals, as described later.

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The prospecting, exploratory, and development stages overlapped; and as more ambitious plans, prompted by the continuance of favorable indications during the progress of the work, were adopted, the scale of operations was expanded. The expansion in operations entailed the clearing of more land, the erection of additional buildings, and the installation of additional equipment of greater capacity. By the time the mine was ready to enter production at the end of August, 1932, there was a clearing of about 70 acres on which there were 35 buildings, a few tents, a steel headframe, a steel water tank and standpipe, a substation connected with the power company line at Elk Falls, and a milling plant of 150 tons daily capacity.

Several of the original structures had been torn down, and on July 15 the inventory of plant and equipment (exclusive of the mill which will be described later) stood as shown in Table 1.

Much of the plant equipment was second-hand material shipped from other properties controlled by the Mining Corporation. Costs shown in Table 1 are the actual dollar costs of new equipment or the fair depreciated value of second-hand equipment, plus freight, hauling, and installation. Unless otherwise stated all frame walls and roofs are covered on the outside with an asbestos-base roll siding or roofing. Building paper or other insulating lining is used between all double floors and in 2-ply frame walls and roofs.

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Table 1.- Appraisal of camp and mine plant buildings and equipment as of July 15, 1932

Building	Date completed	Size, feet	Type of construction	Cost	
				Building	Contents
Main office	April, 1931	20 by 14 by 18 wall, 2 story	6 by 6 inch frame, one-ply lumber walls and roof, rough lumber floors and 3-inch flooring. Inside walls and ceiling 3/8-inch Gyproc. Steam heat and electric lights	$1,475	$1,553
Assay office	April, 1931	20 by 20 by 8 1/2 wall, 6 by 6 balance room	do	855	2,925
Main storehouse and time office	Dec., 1930	24 by 24 by 21 to ridge of roof	Log walls; frame roof. Heated with stove. Electric light. 2 stories	1,700	6,800
Mine supply storehouse	Feb., 1931	24 by 36 by 14 to ridge of roof	do	1,075	4,500
Cookery and dining room	-	-	-	-	2,463
Dining room	Feb., 1931	36 by 29 1/2 by 18 to ridge of roof	1 story; log walls, matched pine floor; frame roof covered with paroid. Ceiled with insulating board	1,150	-
Cookery	Feb., 1932	17 by 29 1/2 by 24 to ridge. 2-story	Frame. Two-ply walls and roof. Insulating board on inside walls and roof	2,269	-
Cookery storehouse	Oct., 1931	24 by 26 by 14 to ridge	Log walls; frame and paroid roof. Heated with stove	500	2,700
Cookery storehouse	March, 1931	22 by 30 by 14 to ridge	6 by 6 inch sills on posts. 1-ply frame. No heat. Electric lights	550	6,300
Meat house	Aug., 1931	12 by 7 by 11 high	Frame; screened but not heated	100	20
Ice house	Feb., 1931	18 by 22	Log walls; frame and paroid roof	375	100
			Forward	10,049	27,366

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Table 1.- Appraisal of camp and mine plant buildings and equipment as of July 15, 1932--Continued

Building	Date completed	Size, feet	Type of construction	Cost: Building	Cost: Contents
			Brought forward	$10,049	$27,366
Bunk house	-	16 by 16	Sectional shack moved from Cobalt. Stove heat, electric light	300	100
Bunk house	Feb., 1932	48 by 24 by 28	2 stories. Frame on posts. 2-ply walls. Dressed lumber inside lined with insulating board. Steam heat, electric light; 14 bedrooms	4,358	1,534
Bunk house	March, 1932	do	Same, except for 24 by 24 by 8 foot cellar	4,174	1,345
Hospital cottage	March, 1932	24 by 28 by 17 to ridge	Sills, 8 by 8 inch. 2-ply rough lumber. Insulating board inside. Steam heat, electric light, bath and lavatory; 3 bedrooms and office	1,352	603
Tent behind main office	-	-	Wooden floor	71	52
Tent for steel erectors	-	12 by 14 x 4 wall	On wooden frame and floor	110	140
One tent and contents of two others	-	-	-	84	138
Building in camps owned by others	-	-	-	-	235
Laundry	June, 1932	18 by 16 by 10 1/2	Walls and roof 1-inch rough boards, matched flooring, electric light	228	27
Stable 1	Dec., 1930	20 by 40	Log walls, Shed roofs, tar paper on poles	200	100
Stable 2	Jan., 1931	20 by 40	do	200	500
Stable 3	Feb., 1931	18 by 30	do	200	-
Stable 4	Feb., 1931	18 by 18 by 14 to ridge	Log walls; roof, frame and tar paper	200	-
Stable 5	March, 1932	19 by 29 by 14 to ridge	do	275	-
Hay shed	Sept., 1931	40 by 30 by 10 to ridge	Frame; 1-inch rough boards and tar paper	100	1,388
Storehouse	Feb., 1931	20 by 30 by 14 to ridge	Frame; all dressed lumber	404	98
			Forward	$22,305	$33,676

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Table 1.- Appraisal of camp and mine plant buildings and equipment as of July 15, 1932--Continued

Building	Date completed	Size, feet	Type of construction	Cost	
				Building	Contents
				$22,305	$33,676
Blacksmith shop	March, 1932	24 by 40 by 18 to ridge	Sills, lagging. Frame with 2-ply 1-inch lumber	1,081	2,756
Dry house	Feb., 1931	16 by 52 by 8 1/2 wall	Sills, 6 by 6 inch; 1-inch floor on 1-inch rough lumber	1,028	200
Lean-to on dry house	-	15 1/2 by 5 1/2 by 8 1/2	do	90	275
Pump house at creek	May, 1932	17 by 11 by 7 wall. 11 to ridge	Concrete foundations and floor. Walls, 12 by 12 by 4 inch tile and red brick. Roof, steel frame and corrugated iron	895	3,150
Fire pump house	June, 1932	14 1/2 by 13 1/2 by 8 high	Concrete floor; hollow-tile walls; ceiling reinforced concrete	435	941
Pipe line to steel tank	-	900 feet 5-inch pipe; 1,800 feet 4-inch pipe. Fittings, etc.	-	2,122	-
Fuse and cap house	June, 1931	8 by 8 by 8	Frame covered with red Flextone. Steam heat, electric lights	125	250
Powder thaw house	Aug., 1931	8 by 8 by 8	Frame covered with paroid. Steam heat, electric light	125	45
Main powder house	June, 1931	24 by 40 by 10 walls. 16 to ridge	2-inch plank floor. Frame walls and roof covered with corrugated iron	500	17,500
Motor shed	Feb., 1932	48 by 14 by 9	Sills, 2-inch lagging. 2-inch plank floor. One-ply frame, 1-inch lumber and tar paper	299	10,397
Machine and carpenter shop	March, 1932	24 by 72 by 10 1/2 wall. 18 to ridge	Sills, 8 by 8 inch. Two-inch plank floor on 1-inch rough lumber. Walls, 2 ply. Steam heat, electric light	2,417	7,25
Electric shop. Lean-to on machine shop	April, 1932	24 by 16	do	409	1,10
Oil house	Feb., 1931	14 by 16	Log walls; frame roof	200	90
			Forward	32,031	78,44

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Table 1.- Appraisal of camp and mine plant buildings and equipment as of July 15, 1932--Concluded

Building	Date completed	Size, feet	Type of construction	Cost	
				Building	Contents
			Brought forward	$32,031	$78,447
Fuel oil and gasoline shed	July, 1931	25 by 25	Roof over steel drums; no walls	50	600
Steam power plant	March, 1931	38 by 56	Log walls, frame roof, plank floor, electric lights	2,700	19,000
Compressor house	March, 1932	60 by 32 by 10 1/2 wall. 19 to ridge of roof	Concrete foundations. Frame, all dressed 1-ply lumber	5,602	24,306
Power line to compressor house	-	-	-	1,075	-
Substation	-	-	-	Owned by power company	975
Power line to pump house	-	-	-	1,031	-
Sawmill and transmission line	-	-	-	-	2,750
Steel water tank	June, 1932	57 feet high	Steel riser and tank capacity 35,000 imperial gallons	5,682	-
Gasoline compressor	-	-	-	-	2,000
Steel headframe and ore bin	-	-	-	9,355	-
Cordwood	-	400 cords at $5.65	-	2,260	-
Hoist and track to woodpile	-	-	-	-	450
Total cost				$59,786	$128,528

Other structures which have been torn down
(Contents inventoried in structures listed above)

Original blacksmith shop	20 by 20	Frame	525	-
Original office	18 by 20	Log walls; frame and tar paper roof	344	-
Pump house at creek			125	-
Timber headframe and ore bin		Sawed timber	1,500	-
Combined bunk house and cookery (original)			390	-
Wooden water tank		6,000 gallons capacity	200	-
Total cost of structures torn down			3,084	-
Total cost of buildings and contents			$62,870	$128,528

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A summary of the principal items of plant equipment, material, and supplies listed as contents in the foregoing schedule follows:

Plant equipment, material, and supplies

Main office. Surveying instruments, office furniture, typewriters, adding machines, etc.; beds, blankets, and mattresses.
Assay office. Laboratory crushers and motor, balances, furnaces, and general laboratory equipment and supplies.
Dry house. Shower, lavatory, pipe radiators, and clothes racks.
Main storehouse and time office. Oil suits, rubber boots, safety hats, carbide lamps, paint, pipe fittings, and sundry hardware.
Mine-supply storehouse. Cement, mill belting, shovels, miners' tools, nails, waste, etc.
Cookery and dining room. Baking oven, camp ranges, electric refrigerator, cooking utensils, tableware and dishes, tables and benches, etc.
Cookery storehouses. Assorment of groceries.
Stable 2. Tools.
Hay shed. Stores 768 bushels of oats, and 44,900 pounds of hay.
Compressor house. One 200-hp., 500-volt, slip-ring motor; one 125-hp. motor; one 75-hp. motor; wiring, switchboard, etc. One 18 by 11 by 16 inch cross-compound compressor, capacity 1,050 cubic feet; one 16 by 10 by 12 inch compressor, capacity 720 cubic feet; belts, piping, etc.; one 42 by 32 inch, 8,000-pound rope-pull electric mine hoist, hoisting cable, etc.; one 16 by 12 inch electric compressor, 50-hp. motor. Cost includes freight and installation.
Bunk houses. Forty-three double-deck beds, 96 mattresses, 98 pillows; chairs, tables; lavatories, hot-water tanks, etc.
Motor shed. Used for storage of following:

5 pumps, 4 by 3 inches
2 Triplex pumps, 5½ by 7 inches
12 small motors, Venturi meter and some mine supplies.

Hospital cottage. Furniture; 4 beds, mattresses, etc.; lavatory and bath tub; steam-heating equipment; general medical supplies.
Machine and carpenter shops. Motor, 25 hp.; shafting, pulleys, and belts; 26 inch by 46 inch by 16 foot lathe; 9-inch radius lathe by 8 feet; 15-inch plain metal shaper; emery grinder; power hack saw; 23-inch upright drill press; 20-inch ripsaw; wood lathe; planer; 30-inch band saw; shop tools; etc.
Electric shop. Miscellaneous electrical supplies.
Main powder house. 113 cases of 40 per cent gelatin dynamite
1,817 cases of 60 per cent gelatin dynamite
34 cases of 75 per cent gelatin dynamite
65 cases of 55 per cent ammonia dynamite

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Plant equipment, material, and supplies - Continued

Blacksmith shop. Two drill sharpeners and spare parts; oil-heating furnace; forge and anvils; set of tools; 5-hp. a.c. motor, etc.
Fire pump house. Two 225-gallon-capacity pumps, piping, and accessories.
Power house (steam). Two 125-hp. return tubular boilers, 72 inch by 14 foot, 2 smokestacks, 2 boiler-feed pumps, feed-water heater, one tandem compound Corliss air compressor, one 12½-kw. d.c. generator; one single-drum, double-cylinder steam hoist, capacity 4,000 pounds at 330 r.p.m., piping, fittings, cement, fire brick, and installation cost.

Shaft Sinking.- By the time preparations were completed for sinking, it had been decided to put down a 3-compartment shaft which would be of suitable size for a working shaft, at least during the early productive period of the operation. A vertical shaft in the footwall would have entailed driving long crosscuts to intersect the vein at the lower levels. A vertical shaft in the hanging wall would, on the other hand, have to be sunk in the swamp to be near the vein, and since diamond drilling had indicated that the hanging-wall rocks were badly fractured and probably wet, it was decided to sink an inclined shaft from the top of the ridge east of the vein and parallel to the dip. The shaft was sunk from a point which would place it approximately 60 feet in the footwall of the vein at an inclination of 53° from the horizontal. An inclined shaft is generally not as satisfactory as a vertical shaft from an operating standpoint, especially for a large production, but the incline shaft was decided upon since a small daily tonnage was anticipated, a lower cost for crosscutting would be required, and the vein could be attacked underground on each of the four contemplated levels in a shorter length of time.

The shaft was started on February 16, 1931, and was sunk in several different stages with intervening interruptions during which crosscuts were driven to the vein. Thus when the 125-foot level was reached, a station was cut, a crosscut was driven to the vein, a few rounds were taken out of the vein, and a loading pocket was partly completed. Sinking was then resumed to the 250-foot level, where another station was cut and another crosscut driven to the vein. The section from the 250 to the 500 foot level was sunk in one operation. The 500-foot level was therefore not reached until November 29, 1931. The shaft was deepened to 504 feet on December 1, and lateral development was then undertaken on the various levels. On that date the lateral development already completed was as follows:

Level	Crosscuts, feet	Drifting and slashing, feet	Total lateral development, feet
125	65	367	432
250	55	372	427
375	19	-	19
Total	139	739	878

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Later on the shaft was deepened to 585 feet to make room for sump and loading pockets below the 500 level.

Until April, 1931, power was furnished by a gasoline-driven compressor which supplied air for drilling and for operating an air-driven hoist. From then till July, 1932, when electric power was available, steam power generated in wood-fired boilers was used.

The shaft is 17 feet by 6 feet 2 inches outside the timbers and was sunk with 3 shifts of 6 shaft men to the shift. Four machines were employed for drilling off the round. The shaft men were all miners; and each shift took up the work where the preceding one left off, whether that work was drilling and blasting, mucking, or timbering.

The shaft is timbered with 7 by 7 inch framed timber and is divided into 3 compartments, two for hoisting in balance with skips and the other for pipes, power lines, and ladderway. Sets were placed on 8-foot centers and were lagged over the top with split-pole lagging. The ladderway is separated from the adjacent skipway by 2-inch rough-sawed sheathing. The shaft was usually advanced 40 feet beyond the last set of timber before the timber was carried ahead. Four sets of timber were thus installed during each timbering cycle; permanent 30-pound rails were laid on 6 by 8 inch stringers placed flat on the bottom timbers of the shaft sets, and pipe lines and ladders were extended when sinking below the timbers; temporary rails were laid in the middle compartment on sprags so that the 1-ton skip employed in mucking could be run to the bottom.

In drilling the shaft rounds, two bars were placed across the shaft, on each of which two machines with arms were mounted. All the holes could be drilled from these set-ups. A center cut of eight holes with four inside easers or "baby cuts" on the hanging-wall side were employed.

Cut holes were drilled with 8-foot steels and the square-up holes with 7-foot steels. Drifter machines were employed. Thirty-six holes were drilled for a complete round and were spaced as shown in Figure 3. The entire round was fired in one blast with delay electric exploders in delays from 0 to 10.

The rounds each averaged a little better than 5 feet of advance, and each cycle (drilling, blasting, and mucking) was completed in about 32 hours. The broken rock was shoveled into a skip of 21-cubic-foot capacity. It required nearly 24 hours to muck out a round, 6 hours of which were used up in clearing smoke, preparation, picking bottom, etc. Due to the inclination and size of the shaft only a few men could work to advantage at a time.

When timbering, four shifts were required to place 4 sets, lag them over, and extend the rails, ladders, and pipes.

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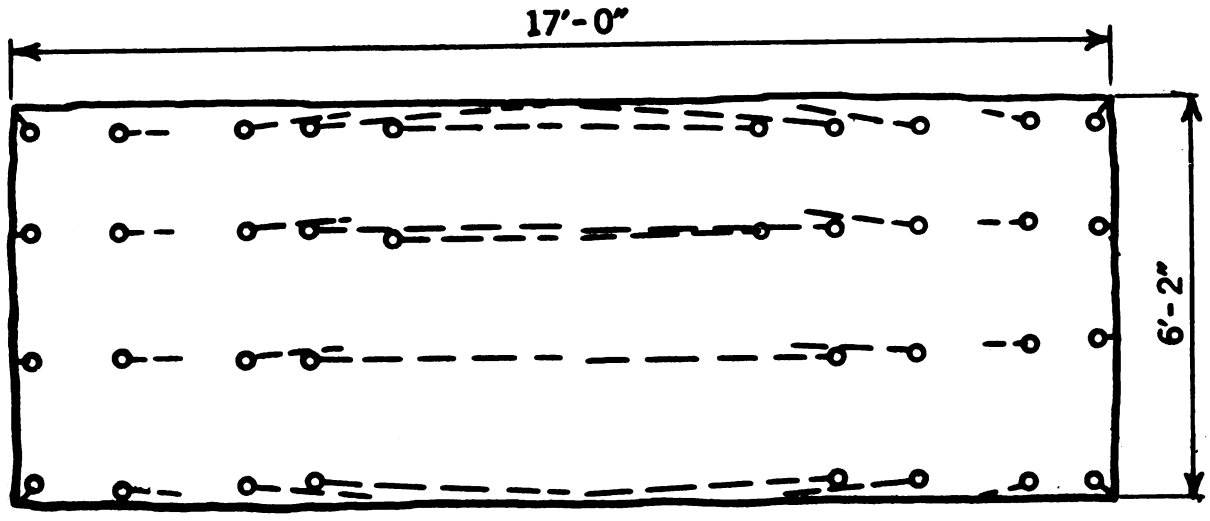

Figure 3.– Shaft round

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Powder consumption averaged about 125 pounds of 50 per cent gelatin dynamite per round or a little less than 25 pounds per foot.

Cost of Sinking.- Due to the fact that sinking was done intermittently with intervening periods of lateral development work, and because when shaft sinking was in progress, all the overhead costs were charged to the shaft, sinking costs were higher than they would otherwise have been.

Sinking costs for direct labor (shaft crew) and explosives during the period from May to December, 1931, inclusive, during which the shaft was advanced 436 feet, were as follows:

	Cost per foot
Wages	$34.00
Bonus	10.19
Explosives	5.46
Total direct labor and explosives	49.65

These costs do not include those for the upper part of the shaft where sinking was somewhat irregular due to the loose nature of the rock, nor for the section below the 500-foot level.

The total cost of sinking and timbering 436 feet, including the first cost of drilling machines, cost of pipes, ladders, etc., is given in Table 2. Indirect labor and supply costs have been arrived at by proration of the general underground accounts between shaft sinking and lateral development.

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Table 2.- Shaft costs

May, 1931, to December, 1931, inclusive.

Feet sunk during period: 436

		Costs per foot
Direct labor:		
Shaft crew		$44.19
Explosives		5.46
Materials and supplies (prorated):		
Cost of rock drills, hose, bars, fittings, and parts	$4.09	
Drill steel	1.20	
Pipe and fittings	4.09	
Timber and timber framing	13.15	
Shaft rails	2.45	
Boiler fuel	9.55	
Gasoline, oils, and grease	3.40	
Subtotal		37.93
Prorated labor:		
Blacksmithing, steel sharpening, drill-repair labor, etc.	3.41	
Decking and surface tramming	3.17	
Hoisting and air compression, including labor hauling boiler fuel	11.28	
General plant teaming	2.08	
General underground labor	4.15	
General surface labor	1.65	
Subtotal		25.74
Total, except office, salaries, medical, etc.		113.32
Salaries, office, medical, etc. (prorated)		5.77
Grand total		119.09

Note: Rock drills, etc., drill steel, fuel and power, gasoline, oils and grease, prorated over 504 feet of shaft. Timber and rails prorated over 585 feet of shaft.

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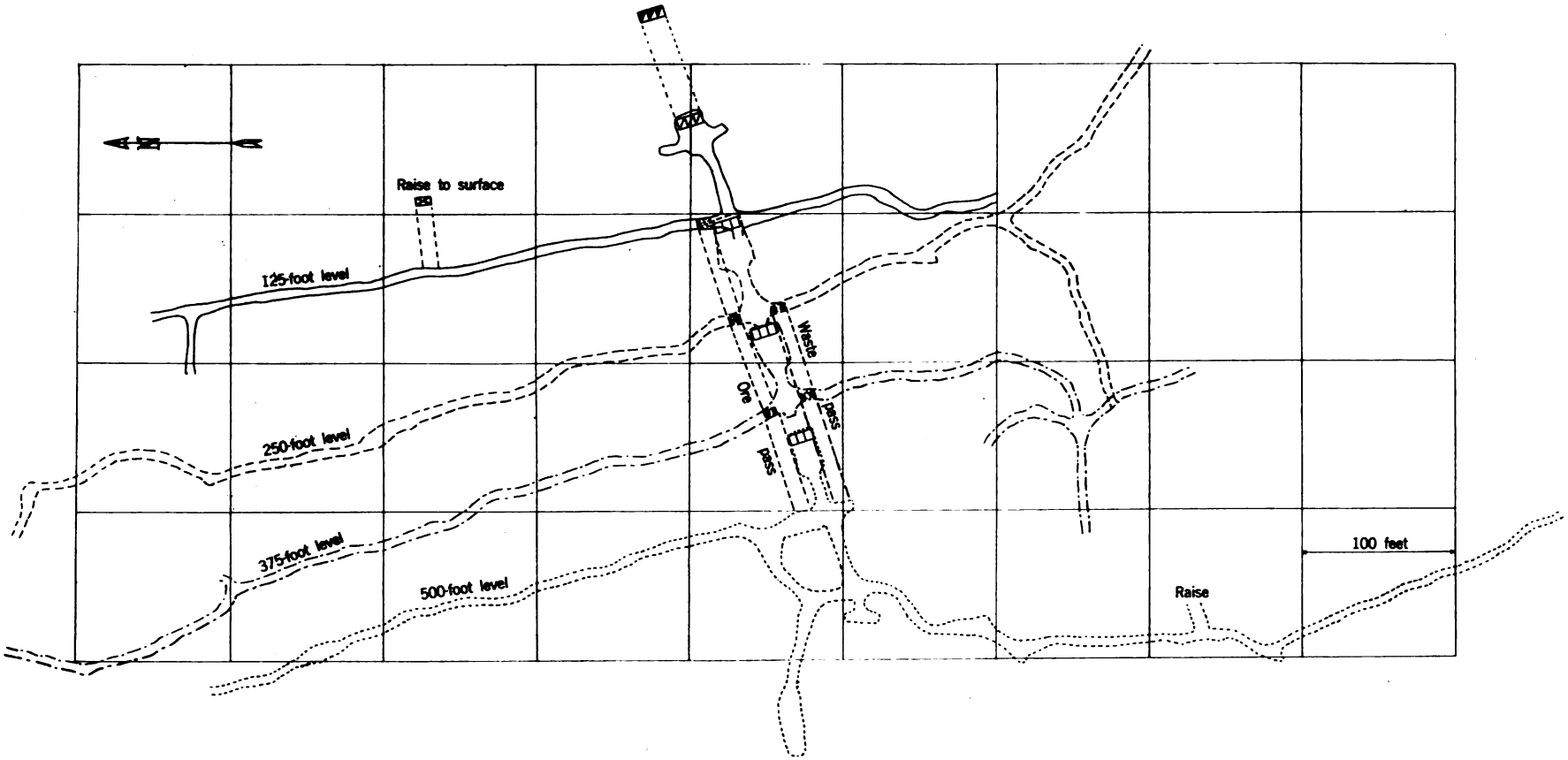

Figure 4.—Plan of levels, August 15, 1932

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Lateral Development.- As previously stated, lateral development was first carried on during the shaft-sinking period at intervals during which sinking was temporarily suspended. From the beginning of the operation until August 15, 1932, lateral development totaled 3,887 linear feet of drifting and slashing and 690 feet of crosscutting, including station crosscuts. In addition an ore pass and a separate waste pass had been driven between the 500 and 125 foot levels by raising, with transfer chutes installed at the 250, 375 and 500 foot levels. Loading pockets were completed below the 125 and 500 foot levels, and a raise was driven from the 125-foot level to surface. Total raising amounted to 721 feet. A station had also been excavated for a winze on the 500-foot level with room for hoist, tracks, etc. Total station excavations amounted to 16,208 cubic feet and loading-pocket excavation to 8,088 cubic feet. Figure 4 is a plan of the mine workings as of August 15, 1932.

Drifts were 5 by 7 feet in cross section, shaft crosscuts 6 by 7 feet, raises 5 by 10 feet, and shaft stations 25 by 18 by 8 feet. The two loading pockets have a combined capacity of 8,088 cubic feet. No timber was required for supporting the ground in drifts, crosscuts, and raises, the only timber used being for staging and manways in driving raises.

In Table 3 are given the costs of lateral development from May 1, 1931, to July 31, 1932. Indirect labor and supplies are prorated between shaft sinking, raising, and lateral development.

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Table 3.- Costs per foot of lateral development

Classification	Drifts, crosscuts, and slashes, 4,308 feet		Raises, 638 feet		Stations and pockets, 230 feet	
Direct labor; drillers, helpers, muckers, and trammers		$6.24		$6.79		$21.23
Explosives		2.91		3.68		3.03
Materials and supplies (prorated):						
Rock drills, accessories, and drill parts	$1.70		$1.94		$4.79	
Drill steel	.60		.68		1.68	
Pipe and fittings	1.03		1.16		2.87	
Track and fittings	1.05		-		-	
Boiler fuel and power	2.09		2.42		5.68	
Oils, gasoline and grease	.75		.84		2.08	
Subtotal		7.22		7.04		17.1
Prorated labor:						
Blacksmith and steel sharpening	.69		1.12		2.75	
Decking and surface tramming	.60		.67		1.66	
Hoisting and air compression including hauling fuel	2.12		2.39		5.90	
General teaming around plant	.39		.44		1.08	
General underground labor	.97		.88		2.17	
General surface and camp labor	.31		.35		.86	
Subtotal		5.08		5.85		14.4
Total except salaries, etc.		21.45		23.36		55.8
Salaries, office, medical, etc.		1.09		1.22		3.0
Grand total		22.54		24.58		58.8

Some stoping was done in August, 1932, to provide feed for the mill which it was planned to start in the latter part of the month. Development ore had been placed on a separate dump on surface, and this stope ore was used to fill the ore passes and pockets prior to starting up the mill.

In Table 4 are summarized the total expenditures (exclusive of the milling plant) from October, 1930, to August 31, 1932.

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Table 4.- Summary of expenditures from October, 1930, to August 31, 1932, exclusive of milling plant

October to December, 1930, inclusive	$12,000	
Less buildings which are included below	2,509	$ 9,491
Camp and mine plant structures as per July 15, 1932, appraisal		62,870
Plant and equipment as per July 15 appraisal		128,528
Pay roll, January 1 to January 15, 1931, not distributed		1,496
Subtotal		202,385

Pay roll, January 15, 1931, to August 31, 1932, not including construction or cookery operation

Surface exploration	$ 2,152	
Road construction	2,647	
Clearing and burning; cutting cordwood, saw logs, and lagging	17,582	
General teaming around plant	4,340	
Saw-mill operation	2,379	
General surface labor	8,629	
Blacksmithing, steel sharpening, nipping, and drill repair labor	9,589	
Operation of power plant, compressors and hoists, including hauling firewood to boilers, and electric power	19,319	
Decking and surface tramming	6,502	
Shaft sinking	25,204	
Cutting shaft stations	2,465	
Cutting loading pockets	2,935	
Driving drifts and crosscuts	25,430	
Driving raises	5,396	
Stoping	1,659	
Starting winze	1,062	
General underground labor	6,484	
Sampling and assaying at mine	4,869	
Office expense, salaries, medical, etc.	15,490	
Freight unloading and checking, February and March, 1932	608	
Additions to buildings	226	
June and July mining (not separated as to class of work)	9,744	
Ore sorting and mill operation, August, 1932	414	
Total pay roll (construction and cookery operation not included)		175,125

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Table 4.- Summary of expenditures from October, 1930, to August 31, 1932, exclusive of milling plant - Continued

Materials and supplies, not included in appraisal		
Explosives, including freight and hauling less inventory	$21,890	
Cordwood less inventory (stump price)	2,100	
Shaft timber (stump price)	2,700	
Drill steel	6,318	
Rock drills, accessories, and parts	13,766	
Pipe and fittings underground	8,250	
Mine rails and fittings installed	6,000	
Rail in stock	2,394	
Pipe and fittings in stock	3,540	
Iron bars, plates, etc., in stock	600	
Mining tools consumed (estimated)	1,500	
26 secondhand 1-ton mine cars including freight and hauling	2,600	
Mine pumps	2,600	
Mine skips and sinking buckets	465	
Miscellaneous supplies such as blacksmith coal, carbide, drill hose, drill steel, etc. (to balance inventory)	1,052	
Total material and supplies not included in appraisal		$75,775
Diamond drilling		29,369
General Accounts		
Fire insurance	$13,991	
Workmen's compensation	5,753	
Airplane travel, 1931 and 1932 up to August 31, 1932	4,709	
Hauling and airplane freight not included in appraisal of plant or in other itemized accounts	19,588	
General travel, outside assaying, and miscellaneous accounts	3,828	
Total general accounts		47,869
Summary of costs except mill and refinery		
Expenditures, October to December, 1930, inclusive, less buildings listed in appraisal	$ 9,491	
Camp and mine plant structures as per July 15, 1932, appraisal	62,870	
Plant equipment as of July 15, 1932, appraisal	128,528	
Pay roll, January 1, 1931 to January 15, 1931	1,496	
Pay roll, January 15, 1931, to August 31, 1932 (construction and cookery operation not included)	175,125	
Materials and supplies not included in appraisal	75,775	
Diamond drilling	29,369	
General accounts	47,869	
Total except mill and refinery		530,523

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MILLING PLANT

On May 17, 1932, excavation was started for a mill designed to handle eventually 200 tons per day. The grinding section of the building is 45 by 48 2/3 feet and forms an end bay of the main mill building which is 152½ by 67¾ feet; the total length is thus 197½ feet.

The superstructure is erected on concrete foundations carried to bed-rock and is of steel frame and trussed steel roof construction. The frame is sheathed with 2-ply lumber separated by hair-felt lining and covered on the outside with J. M. Flextone siding and roofing. The side walls are carried to a height of 17 feet above the foundations and the ridge of the roof is 17 feet higher. The concrete floor slopes from each end and is 3 to 5 feet below the top of the wall foundations.

The refinery occupies a separate building south of the south end of the mill. The building is 26 by 36 feet in plan with hollow-tile walls on concrete foundations. The side walls extend 10 feet above the top of the wall foundations, while the peak of the roof is 16½ feet above the foundations. The roof is carried on steel and is covered with corrugated iron.

The mill is designed to treat 200 tons of ore per day by continuous cyanidation. Some additional grinding equipment will be required, however, to bring the mill up to its full capacity. Corduroy tables are introduced between the ball-mill discharge and the classifier to catch free gold.[4] The concentrates from the tables will be treated by barrel amalgamation. Figure 5 is a flow sheet of the mill.

The cost of the mill and refinery is summarized in Table 5. A considerable part of the equipment was transferred from other mines and is charged at its estimated present value. Costs include freight, teaming, and erection.

4 The tables were subsequently discarded.

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Table 5.- Summary of mill and refinery costs

SUMMARIZED COST OF MILLING PLANT

	Cost
Mill and crusher building:	
Foundations (excavation, concrete foundations, and floors)	$10,050
Structure	24,082
Total	34,132
Refinery:	
Foundation and masonry floor	947
Structure	1,640
Total	2,587

MILL EQUIPMENT

16-inch conveyor belt, 46-foot centers, including freight, hauling, and installation	1,255	
5-hp. motor and switch	280	1,535
Electromagnet, installed complete		1,138
Note: Includes duty $234.32, freight and teaming $36.20, and installation $19.		
4-foot cone crusher	12,000	
75-hp. induction motor	1,510	
Switch and electrical connections	526	
Oil reservoir	78	
Hoist, track and frame over crusher	765	
Foundations	245	15,124
Note: Includes loading and crating $288, freight $214, teaming $513, installation $991.		
Vertical bucket elevator, 50-foot centers, 14-inch belt.		
Elevator installed complete	1,276	
10-hp. induction motor and switch installed	412	
Foundation and pit	150	1,838
125-ton steel ore bin, installed		1,347
16-inch feeder belt, installed, reduction gear and 3-hp. motor, installed		1,075
5 by 16 foot tube mill, installed	11,475	
150-hp. slip ring motor, installed	2,043	
Switch and electrical connections, installed	340	
Foundations	235	14,093
Note: Includes loading and freight $717.		
10-inch vertical bucket elevator, tube mill to classifiers, 26-foot 9-inch centers, installed with pulleys	771	
10-inch vertical bucket elevator, 28-foot centers, installed with pulley	747	
Pits for two bucket elevators	25	1,543
Forward		37,693

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Table 5.- Summary of mill and refinery costs--Continued

MILL EQUIPMENT--Continued

		Cost
Forwarded		$37,693
8-foot by 26-foot 8-inch duplex classifier, installed with shafting, belt, and pulleys	4,434	
10-hp. induction motor, switch, and electrical connections installed	424	
Classifier substructure	651	5,509
Two 30 by 10 foot steel agitators, installed	7,392	
Belts and pulleys	116	
Foundations	510	8,018
Two 30 by 10 foot thickeners, installed	7,680	
Belts and pulleys	116	
Foundations	585	8,381
Two 4-inch duplex diaphragm pumps, installed with belts and pulleys	2,435	
Foundations	16	2,451
Two 5 1/2 by 7 inch triplex pumps, installed complete	4,114	
Foundations	25	4,139
Five 4 by 3-inch centrifugal pumps and 7½-hp. motors, installed	2,477	
Foundations	38	2,515
10-inch, vertical bucket elevator to No. 2 thickener, 20-foot centers		
Elevator installed		717
One American filter, 8-foot 6-inch diameter by 4 leaf, installed with 2-hp. motor, belts and pulleys		7,425
One American, 8-foot 6-inch diameter, by 4-leaf continuous filter, installed complete but not in use		5,250
One emulsifier, installed		257
Merrill precipitation system, installed complete		2,070
Filtrate receiver		240
Foam trap		240
22 by 8 inch single, dry vacuum pump installed complete	1,632	
35-hp. motor, switch, etc., installed	835	
Foundations	31	2,498
One 11 by 9 foot steel unclarified pregnant solution tank installed		460
One clarifying filter, twenty-four 5 by 8 foot leaves, 7-foot 3-inch by 9-foot 10-inch by 6-foot 4-inch deep, installed		2,030
Acid bath for filter leaves, pit, and foundations		172
One steel clarified pregnant solution tank, 16 by 12 feet, installed	960	
Foundation and pit for clarifier tank	130	1,090
Forward		91,155

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Table 5.- Summary of mill and refinery costs--Continued

MILL EQUIPMENT--Continued

		Cost
Forwarded		$91,155
One steel grinding solution tank, 28 by 10 feet, installed ..		1,320
One double-end precipitation filter press, 36 by 36 inches with 10 plates, 9 frames, installed complete		1,785
One barren solution tank, 15 by 11 feet		695
4-inch venturi meter, indicator and integrator, installed complete		1,144
One Singer sewing machine		221
One main-line drive; shafting, belting, couplings, gearing, steel pulley and leather belting, installed, complete ..	980	
35-hp. induction motor compensator, starter, etc.	757	
Motor foundation	10	1,747
One special distributor with pine rotating tank, gearing, pulley, and shafting, installed complete		152
Three 4-foot by 7 foot 8 inches wood, linoleum, and corduroy top tables		105
One 42-inch by 5-foot iron amalgamation barrel installed complete		450
One 2-foot 6-inch by 20-inch clean-up pan		37
One 3-foot 8-inch by 8-foot, 1/8-inch copper amalgamation plate		50
One work table		20
One amalgam press		225
One 3 by 4 by 5 foot, pine concentrate tank		65
Sample crushing room:		
One Sturtevant 2 by 6 inch roll jaw crusher, belt and pulley	248	
One gyratory sample crusher, pulley and belt	176	
One Braun disk pulverizer, belt and pulley	206	
One electric drying oven	91	
Line shaft, pulleys, belting, etc.	86	
One 5-hp. motor, switch and electrical work	259	
One 4 by 6 foot single-deck, roller-bearing, scalper-type screen	950	
One 5-hp. motor	190	
One 3-foot 6-inch by 10-foot air receiver	365	
Foundations	125	2,696
One 15 by 24 inch jaw crusher, installed with wood platform, stairs, and guard rails	3,425	
Leather belt	183	
50-hp. induction motor with pulley, installed	1,075	
Starter, electrical connections, etc.	355	
Foundations	113	5,151
Forward		107,018

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Table 5.- Summary of mill and refinery costs--Concluded

MILL EQUIPMENT--Concluded

	Cost
Forwarded	$107,018
One ore-bin drain tank	75
Mill pipe shop	990
Miscellaneous foundations	71
Total mill equipment and foundations installed complete	108,154

REFINERY EQUIPMENT

Refinery furnace, 40 inches in diameter by 37 inches high, cast-iron trunnion frame and oil burner, installed complete	553	
Foundation	14	567
One oil tank, 3 by 6 feet		105
One hot-metal truck		42
Total		714

SUMMARY OF MILL AND REFINERY COSTS

Mill building and foundations	34,132	
Mill equipment and foundations, installed	108,154	
Refinery building and foundations	2,587	
Refinery equipment installed	714	
Total		145,587

Summery of total expenditures from October, 1930, to August 31, 1932

	Cost
Total mine and camp buildings, equipment, diamond drilling, surface exploration, road construction, and underground development	$530,523
Mill and refinery buildings and equipment installed complete	145,587
Total	676,110

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Legend:

1. Three-compartment inclined shaft
2. Steel waste chute and gate
3. Steel mine bin, 15 by 28 feet. Capacity 170 tons of ore and 70 tons of waste
4. Steel ore-chute gate
5. 15 by 24 inch Universal crusher
6. 14-inch conveyor belt, 41-foot centers
7. Magnet
8. Motor, 3 kilowatt
9. 4-foot cone crusher
10. 14-inch bucket elevator, 50-foot centers
11. 4 by 6 foot Niagara screen
12. Steel mill bin, capacity 125 tons
13. 16-inch feeder conveyor
14. 5 by 16 foot tube mill
15. 8 by 26 foot duplex classifier
16. Three corduroy tables
17. 10-inch bucket elevator
18. No. 1 agitator, 30 by 10 feet
19. No. 2 agitator, 30 by 10 feet
20. No. 1 thickener
21. No. 2 thickener
22. 4-inch diaphragm pump
23. Bucket elevator from mill sump
24. 11 by 9 foot steel pregnant-solution tank
25. Clarifier tank, 18 leaves
26. Triplex clarifier pump
27. 12 by 16 foot steel tank for clarified pregnant solution
28. 3-inch centrifugal booster pump
29. Venturi meter
30. 4 by 8 foot Crow vacuum tank
31. 5 1/2 by 7 inch precipitation pump
32. Zinc mixing cone
33. Zinc feeder
34. Crow vacuum pump
35. Precipitation presses
36. Barren-solution launder
37. 15 by 11 foot barren-solution tank
38. 3-inch barren-solution pump
39. 28 by 10 foot steel grinding-solution tank
40. 3-inch grinding-solution pump
41. Primary leaf filter
42. Filtrate receiver
43. 3-inch filtrate pump
44. 34 by 72 inch foam trap
45. Vacuum pump
46. Emulsifier
47. Secondary leaf filter
48. Filtrate receiver
49. Filtrate pump
50. Foam trap
51. Vacuum pump
52. Tailings launder

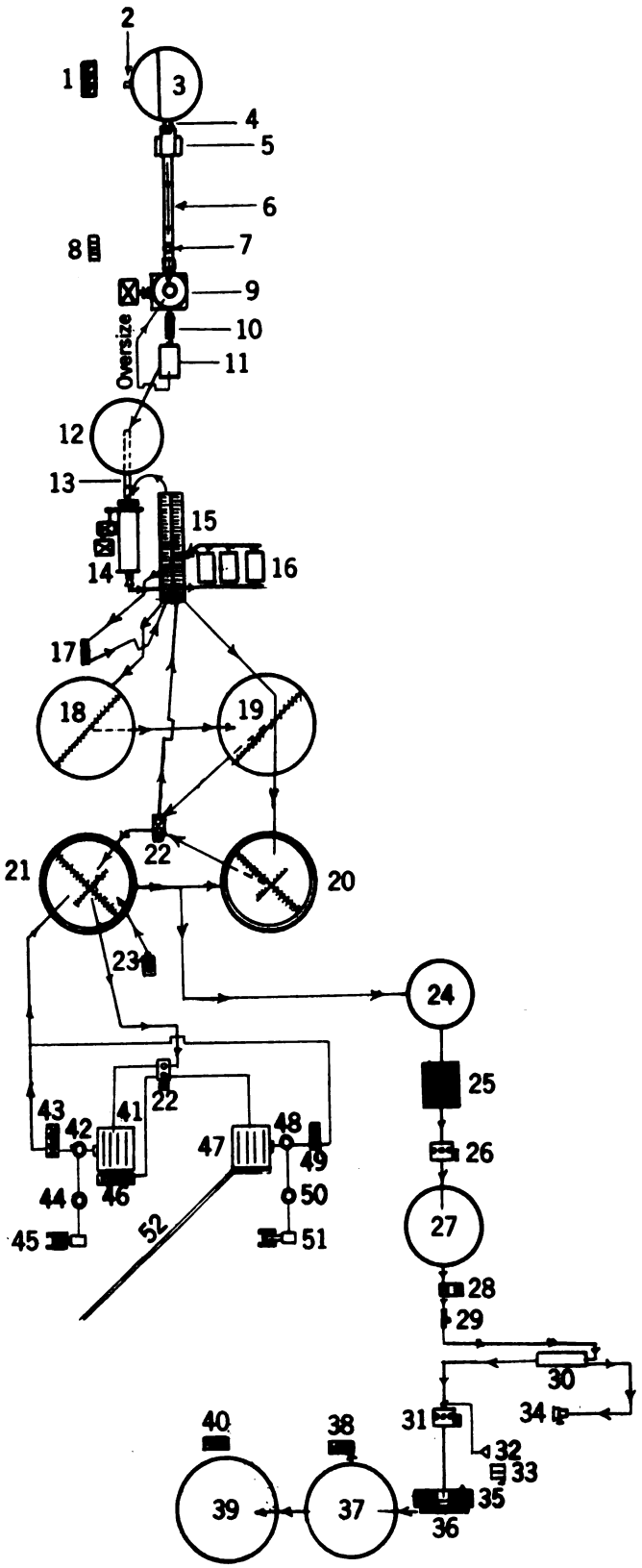

Figure 5.– Flow sheet of mill

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